Some aspects of the phytogeography of West Virginia

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West Virginia has one of the most irregular outlines of any state in the Union. Various "panhandles" and lobes extend its territory to distances relatively far removed from the main body of the state, which fact is significant in any consideration of the phytogeography, as carrying its territory into latitudes and longitudes remarkably distant from one another, in view of the comparatively small area of the entire state. It is variously regarded as one of the northern, southern, eastern, or western states. Its northern "panhandle" extends into the latitude of Staten Island; to the south it extends 60 miles below the latitude of Richmond; its eastern "panhandle" extends 50 miles east of the longitude of Buffalo; and its westernmost tip is 40 miles farther west than Cleveland.

Even more noteworthy from the phytogeographical standpoint are the variations in altitude, ranging from 272 feet at Harper's Ferry to 4860 feet above sea-level on Spruce Knob, Pendleton County. This range in altitude to a large degree overshadows the latitudinal range, so that the coldest temperatures are often reported from the central or southern counties. The accompanying table (Table I) gives the average temperature and precipitation for the state as a whole since 1891, when the official recordations were begun (9).

Table I. Average Temperature and Precipitation for West Virginia, 1890–1930

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann.
Temper.	32.1	32.2	42.6	51.6	62.0	70.1	73.1	71.8	65.8	54.7	42.5	33.3	52.7
Prec.	2.82	3.09	3.94	3.52	3.91	4.47	4.49	4.15	3.03	3.12	2.80	3.51	43.57

The lowest temperature recorded in the state since 1891 was −37° at Lewisburg in 1917. The highest in the same period was 112° at Moorefield in 1930. Some indication of the variations of temperature between various regions of the state may be had by comparing the maxima and minima at Bayard, one of the coldest places in the state, with those at Huntington, one of the warmest. The figures for Moorefield well illustrate the great range in temperature that may occur in a given locality (Table II).

Table II. Maximum and Minimum Temperatures, 1930

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Bayard:												
High	65	68	67	88	88	88	94	95	90	77	73	50
Low	−7	−10	5	23	27	27	34	30	32	8	−14	−12
Huntington:												
High	72	80	76	92	92	105	108	107	98	85	78	59
Low	1	6	15	30	40	42	53	48	44	24	8	14
Moorefield:												
High	80	81	74	98	96	99	109	112	106	86	74	57
Low	−11	−4	15	23	34	29	41	39	39	13	−1	−5

Rainfall is not so evenly distributed over the state as might be expected. It reaches its greatest amount in the high mountains in the central part of the state, where the most luxuriant forests occur, and its lowest point just east of the Alleghenies, where semi-arid conditions are suggestive of the southwestern deserts. At Pickens, in Randolph County, the normal precipitation is 64 inches annually; at Upper Tract, in Pendleton County, hardly 50 miles to the northeast, it is only 29 inches. In the "great drought year" of 1930, while Pickens was receiving ample rainfall, 44 inches, the quantity received at Upper Tract dwindled to 9 inches. In one month of that year (March), Pickens received 6 inches of rainfall, 2/3 of the amount Upper Tract received in the entire 12 months.

The flora of West Virginia has been studied by many of the best known botanists of the country (5). Among these may be mentioned Michaux, who travelled down the Ohio and down the Shenandoah, collecting along the West Virginia shores; Pursh, who collected in Jefferson, Greenbrier, and Monroe Counties; Rafinesque, who collected along the Ohio, South Branch, and Shenandoah; Asa Gray, who travelled through Tygart's Valley, Shaver's Fork, and the headwaters of the Kanawha; Canby, who collected around Grafton; John Merle Coulter, who collected in the Kanawha Valley; and John Donnell Smith, who collected near Grafton and Mannington. The most exhaustive and systematic studies of the flora of the state were carried on independently by C. F. Millspaugh and by John L. Sheldon, the former the author of the latest check-list, dated 1913. Other prominent botanists who have made collections in West Virginia include John K. Small, N. L. Britton, Kenneth K. Mackenzie, P. A. Rydberg, J. M. Greenman, A. S.

Hitchcock, E. S. Steele, Edw. L. Greene, Edgar T. Wherry, and F. W. Pennell. Among amateurs should be noted L. W. Nuttall, a coal operator of Fayette County, who spent most of his spare time from 1890 to 1898 building up a large collection of plants of that county, largely fungi; and Fred W. Gray, a Presbyterian minister of Pocahontas County, who has made an intensive study of the mountain flora, chiefly lichens, bryophytes, and pteridophytes. The list could be greatly extended, if it were made to include all those whose piecemeal contributions have resulted in the accumulation of the present body of our knowledge concerning the flora as a whole. The present staff of the University Botany Department (8) has added the names of hundreds of species new to the state in the course of botanical expeditions that tour the state every summer.

Plant Formations

West Virginia was in its primitive condition practically entirely covered by forests, principally of deciduous trees, but also including a valuable belt of evergreens along the high ridges of the Alleghenies. Classified according to the Life Zones of Merriam (4), the principal species belong to the Upper Austral, Alleghenian, and Canadian Zones, with a sprinkling of species from the Lower Austral and the Hudsonian.

The Deciduous Forests, composed of species of the Upper Austral and Alleghenian Zones, are so well-known as to require no description. Along the river valleys, the forest is composed of *Populus deltoides*, *Betula nigra*, *Castanea pumila*, *Ulmus americana*, *U. fulva*, *Celtis occidentalis*, *Morus rubra*, *Sassafras officinale*, *Liquidambar styraciflua*, *Platanus occidentalis*, *Cercis canadensis*, *Tilia heterophylla*, *Nyssa sylvatica*, *Oxydendrum arboreum*, *Diospyros virginiana*, *Fraxinus americana*, *F. pennsylvanica* and a whole host of herbaceous species. On drier uplands with poorer soils, the following Alleghenian types are dominant: *Carya ovata*, *C. glabra*, *Castanea dentata*, *Quercus alba*, *Q. prinus*. On richer uplands the following are the principal woody species: *Juglans nigra*, *Fagus grandifolia*, *Magnolia acuminata*, *M. Fraseri*, *Liriodendron Tulipifera*, *Hamamelis virginiana*, *Acer saccharum*, and *Rhododendron maximum*.

On the high, cold ridges of the Appalachians the deciduous forests give place to the Coniferous Forests characteristic of

the Canadian Life Zone. The chief components of the Canadian forest found here are: *Tsuga canadensis*, *Pinus resinosa*, *Picea rubra*, *Abies balsamea*, *Betula lutea*, *Amelanchier oligocarpa*, *Pyrus americana*, *Prunus pennsylvanica*, *Acer spicatum*, *A. pennsylvanicum*, *Viburnum alnifolium*, and *Sambucus racemosa;* while on the forest floor may be found *Clintonia borealis*, *Streptopus roseus*, *Maianthemum canadense*, *Trillium undulatum*, *Chrysosplenium americanum*, *Oxalis acetosella*, *Cornus canadensis*, *Chiogenes hispidula*, *Linnaea borealis americana*, and many others. Even the following Hudsonian species occur on exposed, wind-swept summits: *Betula papyrifera*, *Ribes prostratum*, *Rubus strigosus*, *Potentilla tridentata*, *Aralia hispida*, etc.

Here and there throughout the higher mountains, where the drainage is impeded due to resistant masses of conglomerate or other sandstone, are formed topographic features known locally as "glades," which resemble in a striking manner the bogs of farther north. In these glades may be found species of *Sphagnum*, *Cladonia*, etc., as well as such vascular plants as *Aspidium simulatum*, *Larix laricina*, *Carex trisperma*, *Pogonia ophioglossoides*, *Calopogon pulchellum*, *Alnus incana*, *Coptis trifolia*, *Drosera rotundifolia*, *Geum rivale*, *Vaccinium oxycoccos*, *V. macrocarpon*, and *Menyanthes trifoliata*.

A number of species have apparently first appeared in the southern Appalachians as a result of evolution from some other types, and persist in the higher elevations, not as portions of the Canadian flora surrounding them, but as peculiar Appalachian forms. Among such are *Carex Fraseri*, *Melanthium parviflorum*, *Stenanthium gramineum*, *Listera Smallii*, *Thalictrum clavatum*, *Cimicifuga americana*, *Aconitum vaccarum*, *A. uncinatum*, *Trautvetteria carolinensis*, *Magnolia Fraseri*, *Dicentra eximia*, *Parnassia grandifolia*, *P. asarifolia*, *Boykinia aconitifolia*, *Saxifraga micranthidifolia*, *Pachistima Canbyi*, *Euphorbia Darlingtonii*, *Menziesia pilosa*, *Rhododendron catawbiense*, *Vaccinium erythrocarpon*, and *Phlox stolonifera*.

In addition to the above-mentioned deciduous and evergreen forest types, there occurs a third type of plant association, covering many square miles in a narrow strip along the eastern border, to which Steele (7) has given the name SHALE-BARRENS. This is characterized (10) by a sparse, scrubby growth of *Pinus virginiana*, *P. pungens*, *Quercus ilicifolia*, *Kalmia lati-*

folia, and other woody plants, with scattered herbaceous species, including a considerable number of remarkable endemics, among which may be mentioned *Allium oxyphilum*, *Paronychia argyrocoma*, *Eriogonum Alleni*, *Clematis albicoma*, *Arabis serotina*, *Trifolium virginicum*, *Oenothera argillicola*, *Pseudotaenidia montana*, *Phlox Buckleyi*, and *Senecio antennariifolius*. Other plants found on the shale barrens, but not endemic there, include *Woodsia scopulina*, *Cheilanthes lanosa*, *Selaginella rupestris*, *Polygonum tenue*, *Anychia canadensis*, *Silene pennsylvanica*, *Sedum nevii*, *Astragalus distortus*, *Opuntia vulgaris*, *Viola pedata linearilobа*, *Asclepias tuberosa*, *Convolvulus stans*, *Pentstemon canescens*, and *Houstonia tenuifolia*.

Plant Migrations

West Virginia has been constantly above water since the close of the Permian and parts of the state from the Pennsylvanian or even earlier periods. Hence the present flora is the result of plant migrations that have been going on for an enormously long period of time. The Pennsylvanian and Permian floras were extraordinarily rich in species of Pteridophytes and Pteridosperms (11). At the close of the Permian, the Appalachian Revolution (16), culminating in the elevation of the Appalachian Mountains, produced conditions extremely unfavorable to the ancient marsh-loving flora and resulted in the extinction of innumerable types. During the long ages of Triassic and Jurassic times, the region was again base-leveled and the Coastal Plain, as known today, entirely submerged. Into this peneplained region came the advance hosts of the newly evolved angiosperms, representatives of prevailingly tropical groups, ranging far to the north as a response to the mild climate of the time. Then, at the close of the Mesozoic or early in the Cenozoic, the peneplained Appalachian region was again uplifted, resulting in "its inevitable conversion from a low Cretaceous plain with retarded drainage into a vast mesophytic area" (1), into which, Fernald believes, the abundant mesophytic flora of northern Asia, Europe and North America (then connected by land-bridges) was enabled to migrate, forcing the members of the old tropical and sub-tropical groups to abandon their haunts in the Appalachian upland "and to move out to the newly available xerophytic and hydrophytic habitats of the rising Coastal

Plain, where the acid savannahs, bogs, shallow pools and dry sands" supplied the environment in which they could still survive. In favorable habitats on the now uplifted peneplain, however, Kearney (3) thinks some Cretaceous species were able to maintain themselves and so have survived as relict colonies, the most ancient elements of the present Appalachian flora. In a list of such species, common to both the Coastal Plain and the mid-Appalachian region of West Virginia, there should be mentioned *Kyllinga pumila*, *Orontium aquaticum*, *Xyris arenicola*, *Xerophyllum asphodeloides*, *Amianthium muscaetoxicum*, *Melanthium latifolium*, *Agave virginica*, *Phoradendron flavescens* *Clitoria mariana*, *Stylosanthes biflora*, *Passiflora incarnata*, *Rhexia virginica*, *Bartonia virginica*, and *Coreopsis major*. The great majority of the present species may be regarded as the more or less modified descendants of this invading mesophytic flora of late Mesozoic or early Cenozoic times. Many of the genera, then widespread throughout the northern hemisphere, have since been reduced by various exigencies to geographically segregated remnants, persisting in widely separated places. Among such ancient genera may be noted *Arisaema*, *Symplocarpus*, *Chamaelirium*, *Aletris*, *Saururus*, *Menispermum*, *Zanthoxylum* *Podophyllum*, *Caulophyllum*, *Phytolacca*, *Maclura*, *Laportea*, *Magnolia*, *Penthorum*, *Hamamelis*, *Liquidambar*, *Hydrangea*, *Phryma* and *Triosteum*.

The Pleistocene glaciation did not reach West Virginia, the terminal moraine being 25 miles or more from the northern boundaries, yet it is probable that at that time at least the northern part of the state must have presented the aspect of an Arctic tundra, while many Canadian species were forced hundreds of miles farther south. Upon the retreat of the ice sheet and the consequent northward migration of biota, some of these species were left behind on the cold mountain tops throughout the Appalachians. Relict colonies of tundra, persisting in mountain glades, were surrounded by the migrating forests and are still in process of being replaced by succession (2).

Probably reaching West Virginia since the last glaciation, there are a few species which have wandered eastward from the prairie province, such as *Astragalus distortus*, *Silphium perfoliatum*, *Pentstemon canescens*, and *Asclepias verticillata*.

There should also be included in the flora a few species ap-

parently of Rocky Mountain derivation, such as *Woodsia scopulina*, *Eriogonum Alleni*, and *Senecio antennariifolius*, whose ancestors, Wherry (10) suggests, may have migrated eastward across northern North America and made their way southward along the Appalachians in pre-glacial times.

Finally, there should be mentioned, of course, the hundreds of weeds, introduced from Europe and elsewhere in the last three centuries, which have come to be the dominant species of clearings and waste grounds.

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